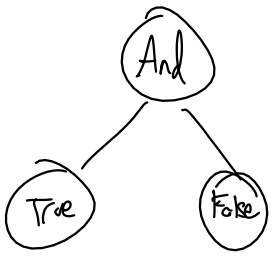
F♭

interpreter : AST → value

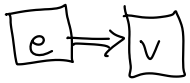
compiler : AST → computer-readable



True And False

An operational semantics is a relation describing meaning of a program.

defined using a set of inference rules



F♭ Grammar

$v ::= 0 \mid 1 \mid -1 \mid \cdots \mid \text{True} \mid \text{False} \mid \text{Function } x \to e$

$e ::= v \mid e + e \mid e - e \mid e = e \mid \text{Not } e \mid e \text{ Or } e \mid e \text{ And } e \mid e\ e \mid \text{Let } x = e \text{ In } e \mid x$

$x ::= \text{(variables)}$

$e \Rightarrow v$

True And False ⇒ False

~~True Or 2 ⇒ True~~

$$\frac{}{\text{True} \Rightarrow \text{True}} \qquad \frac{}{\text{False} \Rightarrow \text{False}}$$

$$\frac{e_1 \Rightarrow \text{True} \quad e_2 \Rightarrow v \quad v \in \{\text{True}, \text{False}\}}{e_1 \text{ Or } e_2 \Rightarrow \text{True}}$$

$$\frac{e_1 \Rightarrow v_1 \quad e_2 \Rightarrow v_2 \quad v \text{ is logical (disjunction) of } v_1, v_2}{e_1 \text{ Or } e_2 \Rightarrow v}$$

or

$$\frac{}{v \Rightarrow v}$$

$$\frac{e_1 \Rightarrow v_1 \quad e_2 \Rightarrow v_2 \quad v \text{ is arithmetic sum of } v_1 \text{ and } v_2}{e_1 + e_2 \Rightarrow v}$$

(Function x → x + 1) 5 ⟹ 6

(Function x → Function y → x − y) 3 1 ⟹ 2

(Function z → Function w → z And w) True ⟹ Function w → True And w

(Function a → Function a → a) 5 ⟹ Function a → a

```
int x = 0;
if (b) {
    int x = 1;
    cout << x << endl;
}
```

Each occurrence of a variable as an expression is either bound or free.

Function a → Function b → a + b + c (c: free; a, b: bound)

a + Function a → a

An expression containing free variable occurrences is open.
An expression not ..... is closed.
Fb opsem: e ⇒ v only for closed e

a ⇏

1 + True ⇏

divergence: infinite loop, stuck

imaginary proof

(a+1)[4/a] = 4+1 4+1 ⇒ 5

(Function a → a + 1) 4 ⇒ 5

e[v/x] (substitution)

True[v/x] = True

x[v/x] = v

x'[v/x] = x' x ≠ x'

(e1 + e2)[v/x] = (e1[v/x]) + (e2[v/x])

Inner function:

(Function x' → e)[v/x] = Function x' → e[v/x] x ≠ x'

(Function x → e)[v/x] = Function x → e